

What is claimed is:

1. A method of modulating grain size in a polysilicon layer comprising:

forming said layer of polysilicon on a substrate; and

performing an ion implantation of a polysilicon grain

size modulating species into said polysilicon layer such

that an average resultant grain size of the implanted

polysilicon layer after performing a pre-determined annealing process.

is higher or lower than an average resultant grain size than

would be obtained after performing the same pre-determined

anneal on the polysilicon layer without a polysilicon grain

size modulating species ion implant.

2. The method of claim 1, wherein said polysilicon grain

size modulating species is selected from the group

consisting of antimony and carbon.

3. The method of claim 1 wherein said polysilicon grain size

modulating species is antimony and is implanted at a dose of

1E15 to 1.5E16 atm/cm<sup>2</sup> and at an energy of 30 to 70 KeV.

1       4. The method of claim 1 wherein said polysilicon grain size  
2       modulating species is carbon and is implanted at a dose of  
3       1E14 to 1E16 atm/cm<sup>2</sup> and at an energy of 15 to 35 Kev.

1           5. A method of fabricating a bipolar transistor having a  
2           collector, a base and a polysilicon emitter comprising;  
3           implanting a dopant species and a polysilicon grain  
4           size modulating species into said polysilicon emitter; and  
5           annealing the implanted polysilicon emitter.

1           6. The method of claim 5, wherein said dopant species is  
2           arsenic.

1           7. The method of claim 5, wherein said polysilicon grain  
2           size modulating species is selected from the group  
3           consisting of antimony and carbon.

1           8. The method of claim 5, wherein the base current of said  
2           bipolar transistor is higher or lower than the base current  
3           of an identical bipolar transistor fabricated without said  
4           polysilicon grain size modulating ion implantation step.

1           9. The method of claim 5, wherein the resistance of said  
2           emitter of said bipolar transistor is higher or lower than  
3           the emitter resistance of an identical bipolar transistor

fabricated without said polysilicon grain size modulating species ion implantation step.

10. The method of claim 5, wherein said dopant species is arsenic and is implanted at a dose of 1E15 to 2.3E16 atm/cm<sup>2</sup> and at an energy of about 40 to 70 Kev, and wherein said polysilicon grain size modulating species is antimony and is implanted at a dose of 1E15 to 1.5E16 atm/cm<sup>2</sup> and at an energy of 30 to 70 Kev.

11. The method of claim 5, wherein said dopant species is arsenic and is implanted at a dose of 1E15 to 2.3E16 atm/cm<sup>2</sup> and at an energy of about 40 to 70 Kev, and wherein said polysilicon grain size modulating species is carbon and is implanted at a dose of 1E14 to 1E16 atm/cm<sup>2</sup> and at an energy of 15 to 35 Kev.

12. The method of claim 5, wherein said annealing is performed using a rapid thermal anneal process at 900 to 1000°C for about 5 to 20 seconds.

1           13. A method of modulating a dopant species concentration  
2           profile in a polysilicon layer of a device comprising;  
3           implanting a dopant species and a polysilicon grain  
4           size modulating species into said polysilicon layer; and  
5           annealing the implanted polysilicon layer.

1           14. The method of claim 13, wherein said dopant species is  
2           arsenic.

1           15. The method of claim 13, wherein said polysilicon grain  
2           size modulating species is selected from the group  
3           consisting of antimony and carbon.

1           16. The method of claim 13, wherein said dopant species is  
2           arsenic and is implanted at a dose of 1E15 to 2.3E16 atm/cm<sup>2</sup>  
3           and at an energy of about 40 to 70 Kev, and wherein said  
4           polysilicon grain size modulating species is antimony and is  
5           implanted at a dose of 1E15 to 1.5E16 atm/cm<sup>2</sup> and at an  
6           energy of 30 to 70 Kev.

1           17. The method of claim 13, wherein the concentration of  
2           dopant is higher at a predetermined distance from a bottom

3           surface of said polysilicon layer than the concentration of  
4           dopant at the same pre-determined distance from a bottom of  
5           an identical polysilicon layer of an identical device  
6           fabricated without said polysilicon grain size modulating  
7           ion implantation step.

1           18. The method of claim 13, wherein said annealing is  
2           performed using a rapid thermal anneal process at 900 to  
3           1000°C for about 5 to 20 seconds.

1           19. The method of claim 13, wherein said polysilicon layer  
2           forms at least a portion of a structure selected from the  
3           group consisting of polysilicon gates of field effect  
4           transistors, polysilicon emitters of bipolar transistors,  
5           polysilicon lines of thin film resistors and polysilicon  
6           lines of damascened thin film resistors.

1           20. A bipolar transistor comprising;  
2            a collector;  
3            a base; and  
4            a polysilicon emitter containing a dopant species and a  
5            polysilicon grain size modulating species.

1           21. The bipolar transistor of claim 20, wherein said dopant  
2            species is arsenic.

1           22. The bipolar transistor of claim 20, wherein said  
2            polysilicon grain size modulating species is selected from  
3            the group consisting of antimony and carbon.

1           23. The bipolar transistor of claim 20, wherein the base  
2            current of said bipolar transistor is higher or lower than  
3            the base current of an identical bipolar transistor  
4            fabricated without said polysilicon grain size modulating  
5            ion implantation step.

1           24. The bipolar transistor of claim 20, wherein the  
2            resistance of said emitter of said bipolar transistor is  
3            higher or lower than the emitter resistance of an identical

4           bipolar transistor fabricated without said polysilicon grain  
5           size modulating species ion implantation step.

1           25. The bipolar transistor of claim 20, wherein said dopant  
2           species is arsenic and is implanted into said polysilicon  
3           emitter at a dose of 1E15 to 2.3E16 atm/cm<sup>2</sup> and at an energy  
4           of about 40 to 70 Kev, and wherein said polysilicon grain  
5           size modulating species is antimony and is implanted into  
6           said polysilicon emitter at a dose of 1E15 to 1.5E16 atm/cm<sup>2</sup>  
7           and at an energy of 30 to 70 Kev.

1           26. The bipolar transistor of claim 20, wherein said dopant  
2           species is arsenic and is implanted into said polysilicon  
3           emitter at a dose of 1E15 to 2.3E16 atm/cm<sup>2</sup> and at an energy  
4           of about 40 to 70 Kev, and wherein said polysilicon grain  
5           size modulating species is carbon and is implanted into said  
6           polysilicon emitter at a dose of 1E14 to 1E16 atm/cm<sup>2</sup> and at  
7           an energy of 15 to 35 Kev.

1           27. A device comprising;  
2                    a polysilicon layer forming at least a portion of a  
3                    structure of said device; and  
4                    said polysilicon layer containing a dopant species and  
5                    a polysilicon grain size modulating species.

1           28. The device of claim 27, wherein said dopant species is  
2                    arsenic.

1           29. The device of claim 27, wherein said polysilicon grain  
2                    size modulating species is selected from the group  
3                    consisting of antimony and carbon.

1           30. The device of claim 27, wherein said dopant species is  
2                    arsenic and is implanted into said polysilicon layer at a  
3                    dose of 1E15 to 2.3E16 atm/cm<sup>2</sup> and at an energy of about 40  
4                    to 70 Kev, and wherein said polysilicon grain size  
5                    modulating species is antimony and is implanted into said  
6                    polysilicon layer at a dose of 1E15 to 1.5E16 atm/cm<sup>2</sup> and at  
7                    an energy of 30 to 70 Kev.

1       31. The device of claim 27, wherein the concentration of  
2       dopant is higher at a predetermined distance from a bottom  
3       surface of said polysilicon layer than the concentration of  
4       dopant at the same pre-determined distance from a bottom of  
5       an identical polysilicon layer of an identical device  
6       fabricated without said polysilicon grain size modulating  
7       ion implantation step.

1       32. The device of claim 27, wherein said portion of a  
2       structure of said device is selected from the group  
3       consisting of polysilicon gates of field effect transistors,  
4       polysilicon gates of bipolar transistors, polysilicon lines  
5       of thin film resistors and polysilicon lines of damascened  
6       thin film resistors.